



REQUEST FOR RECONSIDERATION

Claims 1-18 remain active in this application.

The claimed invention is directed to a process for partially oxidizing propene to acrylic acid in the gas phase under heterogeneous catalysis. Applicants have discovered benefits for a catalysis process comprising successive fixed catalyst bed zones wherein the site of transition from a temperature zone A to a temperature zone B **does not coincide with** a transition from one fixed catalyst bed zone to another fixed catalyst bed zone. Such a process is nowhere disclosed or suggested in the cited prior art of record.

The rejection of claims 1-18 under 35 U.S.C. § 112, second paragraph, is respectfully traversed.

Applicants respectfully submit that term “substantially constant” as it pertains to the volume-specific activity of a fixed catalyst bed zone is clear to those of ordinary skill in the art such that the metes and bounds of the claimed invention are clear to those of ordinary skill in the art.

In the area of acrylic acid production by catalytic oxidation, fixed catalyst bed zones having a substantially constant volume-specific activity are known (e.g. EP 1106598) (U.S. 6,620,968) (page 3, lines 13-19 of the above-identified specification).

The allowed claims of co-pending application 10/808,282 use the term “substantially constant” to refer to the volume-specific activity of a fixed catalyst bed zone as follows:

1. A process for partially oxidizing propene to acrylic acid in the gas phase under heterogeneous catalysis by conducting a starting reaction gas mixture 1 comprising propene, molecular oxygen and at least one inert gas in a first reaction stage over a fixed catalyst bed 1 whose active composition is at least one multimetal oxide comprising the elements Mo, Fe and Bi, in such a way that

the fixed catalyst bed 1 is arranged in two spatially successive temperature zones A, B,

both the temperature of temperature zone A and the temperature of temperature zone B are a temperature in the range from 290 to 380°C.,

the fixed catalyst bed 1 consists of at least two spatially successive fixed catalyst bed zones, and the volume-specific activity within one fixed catalyst bed zone is **substantially constant** and increases sharply in the flow direction of the reaction gas mixture 1 at the transition from one fixed catalyst bed zone to another fixed catalyst bed zone,

the temperature zone A extends up to a conversion of the propene of from 40 to 80 mol %,

on single pass of the starting reaction gas mixture 1 through the entire fixed catalyst bed 1, the propene conversion is  $\geq 90$  mol % and the selectivity of acrolein formation and also of acrylic acid by-production taken together and based on converted propene are  $\geq 90$  mol %, the sequence in time in which the reaction gas mixture 1 flows through the temperature zones A, B corresponds to the alphabetic sequence of the temperature zones A, B,

the hourly space velocity of the propene contained in the starting reaction gas mixture 1 on the fixed catalyst bed 1 is  $\geq 90$  l (STP) of propene/l of fixed bed catalyst  $\cdot$  h

the difference  $T^{\max A} - T^{\max B}$ , formed from the highest temperature  $T^{\max A}$  which the reaction gas mixture 1 has within temperature zone A, and the highest temperature  $T^{\max B}$  which the reaction gas mixture 1 has within temperature zone B is  $\geq 0^\circ\text{C}$ .,

optionally reducing the temperature of the product gas mixture leaving the first reaction stage by cooling and optionally adding molecular oxygen and/or inert gas to the product gas mixture, and afterward conducting the product gas mixture as a starting reaction gas mixture 2 which comprises acrolein, molecular oxygen and at least one inert gas, and contains the molecular oxygen and the acrolein in a molar  $\text{O}_2:\text{C}_3\text{H}_4\text{O}$  ratio of  $\geq 0.5$  in a second reaction stage over a fixed catalyst bed 2 whose active composition is at least one multimetal oxide comprising the elements Mo and V, in such a way that

the fixed catalyst bed 2 is arranged in two spatially successive temperature zones C, D,

both the temperature of temperature zone C and the temperature of temperature zone D are a temperature in the range from 230 to  $320^\circ\text{C}$ .,

the fixed catalyst bed 2 consists of at least two spatially successive fixed catalyst bed zones, and the volume-specific activity within one fixed catalyst bed zone is **substantially constant** and increases sharply in the flow direction of the reaction gas mixture 2 at the transition from one fixed catalyst bed zone to another fixed catalyst bed zone,

the temperature zone C extends up to a conversion of the acrolein of from 45 to 85 mol %, on single pass of the starting reaction gas mixture 2 through the entire fixed catalyst bed, the acrolein conversion is  $\geq 90$  mol % and the selectivity of acrylic acid formation, based on propene converted over both reaction stages, is  $\geq 80$  mol %,

the sequence in time in which the reaction gas mixture flows through the temperature zones C, D corresponds to the alphabetic sequence of the temperature zones C, D,

the hourly space velocity of the acrolein contained in the starting reaction gas mixture 2 on the fixed catalyst bed 2 is  $\geq 70$  l (STP) of acrolein/l of fixed bed catalyst  $2 \cdot h$

the difference  $T^{\max C} - T^{\max D}$ , formed from the highest temperature  $T^{\max C}$  which the reaction gas mixture has within temperature zone C, and the highest temperature  $T^{\max D}$  which the reaction gas mixture has within temperature zone D is  $\geq 0^{\circ}C.$ ,

wherein neither the transition from temperature zone A to temperature zone B in fixed catalyst bed 1 nor the transition from temperature zone C to temperature zone D in fixed catalyst bed 2 coincides with a transition from one fixed catalyst bed zone to another fixed catalyst bed zone.

U.S. 7,015,354 uses the term “substantially constant” to refer to conversion of charging gas and composition of a charging gas mixture as follows:

1. A process for preparing (meth)acrolein and/or (meth)acrylic acid by heterogeneously catalyzed gas phase partial oxidation by charging a fresh fixed catalyst bed disposed in a reactor at elevated temperature with a charging gas mixture which, in addition to at least one organic precursor compound to be partially oxidized and molecular oxygen as an oxidant, comprises at least one diluent gas which behaves substantially inertly under the conditions of the heterogeneously catalyzed gas phase partial oxidation, which comprises carrying out the process, after the composition of the charging gas mixture has been established, at **substantially constant** conversion of the organic precursor compound and at **substantially constant** composition of the charging gas mixture, initially over a startup period of from 3 days to 10 days at a low hourly space velocity and subsequently at a higher hourly space velocity of the charging gas mixture on the catalyst charge.

Thus the term “substantially constant” is well used by those of ordinary skill in the art to describe the catalyst activity of a fixed catalyst bed zone as it relates to the claimed technology of gas phase partial oxidation on a heterogeneous catalyst bed.

Moreover, the phrase “substantially constant” is well accepted in patent claims. Some examples are as follows:

U.S. 7,114,566, uses the term “substantially constant” with respect to a rate of oxidation as follows:

20. The method of claim 8, further comprising increasing a volume of the reaction zone, and increasing the flow of the oxidizing fluid to the reaction zone such that a rate of oxidation in the reaction zone is **substantially constant** over time.

21. The method of claim 8, further comprising maintaining a **substantially constant** rate of oxidation in the reaction zone over time.

U.S. 7,060,649 uses the term “substantially constant” with respect to a speed of passing a catalyst precursor as follows:

1. A process for preparing a vanadium, phosphorus, and oxygen containing catalyst suitable for heterogeneously catalyzed gas-phase oxidation of a hydrocarbon having at least four carbon atoms to maleic anhydride, in which a corresponding vanadium, phosphorus, and oxygen containing catalyst precursor containing particles having an averaged diameter of at least 2 mm is converted into a catalytically active form by calcining, which comprises passing a stream of the catalyst precursor for calcining at **substantially constant** speed through at least one calcining zone  $n$  of length  $l_n$  on a conveyor belt, the fluctuation in the gas temperature from a setpoint value over time at each point in the region of the stream of the catalyst precursor after half the length of the calcining zone,  $l_n/2$ , being in each case  $\leq 5^\circ\text{C}$ . and the local difference in gas temperature between any two points in the region of the stream of the catalyst precursor after half the length of the calcining zone,  $l_n/2$ , being in each case  $\leq 5^\circ\text{C}$ .

U.S. 6,017,661 uses the term “substantially constant” with respect to temperature of a heat source as follows:

20. The method of claim 1, wherein the synthesis gas is removed from a producer well equipped with a heating source, and wherein a portion of the heating source adjacent to a synthesis gas producing zone operates at a **substantially constant** temperature to promote production of the synthesis gas wherein the synthesis gas has a selected composition.

21. The method of claim 20, wherein the **substantially constant** temperature is about  $700^\circ\text{C}$ , and wherein the selected composition has a  $\text{H}_2$  to CO ratio of about 2:1.

U.S. 6,972,276 refers to the term “substantially constant” with respect to reaction mixture temperature as follows:

3. A process according to claim 1, wherein said reaction mixture is maintained at a **substantially constant** temperature.

U.S. 6,964,753 uses the term “substantially constant” with respect to temperature and flow rate values of a polymer as follows:

1. A continuous static polymerisation reactor unit for the production of liquid polymers in a predetermined viscosity range which comprises: a) a reactor comprising an elongate hollow reaction chamber having two ends, one end defining an inlet means adapted for the introduction of a reaction mixture into the reaction chamber, and the other end defining an outlet means; b) a supply means in communication with

the inlet means for supplying liquid monomers, oligomers, or mixtures thereof to said inlet means; and c) means for introducing at least one viscosity controlling agent into the supply means to form a reaction mixture with the monomers, oligomers or mixtures thereof,

wherein the temperature and flow rate values of the resulting polymer in the elongate hollow reaction chamber are maintained **substantially constant**; and d) a control means adapted to detect and correct any variation from a predetermined pressure drop value between the inlet means and the outlet means.

U.S. 6,962,193 refers to the term “substantially constant” with respect to pressure of a bleed air as follows:

22. The catalytic precooler described in claim 36, wherein the bundle of tube assemblies has a receiving end and a delivery end, the entry end of each tube assembly comprising the receiving end, the exit end of each tube assembly comprising the delivery end, the bleed air being directed towards the receiving end so that different bleed air pressures are presented to each entry end of each tube assembly, the bleed air exiting from each exit end having a **substantially constant** pressure, and the pressure drop between the entry end and the exit end of each tube assembly being controlled by differing turbulator configurations.

U.S. 6,919,290 refers to the phrase “substantially constant” with respect to hydrogen content value as follows:

22. A process as claimed in claim 1 wherein at least a portion of the second gaseous stream is recycled to the reactor system to form at least part of the first gaseous stream and make-up hydrogen is introduced to the gaseous recycle stream so as to maintain the hydrogen content of the first gaseous stream at a **substantially constant** value.

U.S. 6,884,858 uses the term “substantially constant” with respect to reaction temperature as follows:

1. A single-stage liquid phase polymerization process for preparing a polyolefin product having preselected properties, said process comprising: providing a liquid feedstock comprising at least one olefinic component; providing a catalyst composition comprising a complex of  $\text{BF}_3$  and a complexing agent therefor, said complexing agent comprising a glycol or an aliphatic alcohol having a primary hydroxyl group and no hydrogen on a beta carbon, said complex being stable at temperatures needed to produce said polyolefin product; introducing said feedstock and said catalyst composition into a residual reaction mixture in a loop reactor reaction zone, said reaction zone comprising a tube side of a shell-and-tube heat exchanger; recirculating the residual reaction mixture with the feedstock and the catalyst composition therein in said zone at a recirculation rate sufficient to establish a Reynolds number of at least about 2000 in the zone and thereby cause intimate

intermixing of the residual reaction mixture, the feedstock and the catalyst composition to thereby present a recirculating, intimately intermixed reaction admixture of the residual reaction mixture, the feedstock and the catalyst composition in said reaction zone; maintaining the recirculating intimately intermixed reaction admixture in its intimately intermixed condition and removing heat of reaction from the reaction admixture at a rate calculated to provide a **substantially constant** reaction temperature in the reaction admixture while the same is recirculating in said reaction zone, said constant reaction temperature being at a level appropriate for causing olefinic components introduced in said feedstock to undergo polymerization to form said polyolefin product in the presence of said catalyst composition; withdrawing a product stream comprising polyolefin product and catalyst composition from said reaction zone; adding a quenching material capable of killing the catalyst to the withdrawn product stream; and controlling the introduction of said feedstock into said reaction zone and the withdrawal of said product stream from the reaction zone such that the residence time of the olefinic components undergoing polymerization in the reaction zone is appropriate for production of said polyolefin product.

U.S. 6,880,635 refers to the term “substantially constant” with respect to temperature of a production well as follows:

77. The method of claim 62, wherein removing a portion of the second synthesis gas comprises withdrawing second synthesis gas through a production well, wherein a temperature of the production well adjacent to a production zone of the second synthesis gas is maintained at a **substantially constant** temperature such that the H<sub>2</sub> to CO ratio of the second synthesis gas is greater than the H<sub>2</sub> to CO ratio of the first synthesis gas.

U.S. 6,881,702 uses the term “substantially constant” with respect to the speed of passing a catalyst precursor as follows:

1. A process for the preparation of a catalyst, comprising: preparing a particulate catalyst precursor which contains oxides and/or compounds of elements other than oxygen which constitute a multimetal oxide material, wherein said compounds of elements other than oxygen can be converted into oxides, and converting said particulate catalyst precursor by calcination into a catalytically active form by passing a stream of said particulate catalyst precursor at **substantially constant** speed through at least one calcination zone for calcination and passing a gas stream through the stream of said particulate catalyst precursor perpendicularly to the direction of advance of the stream of said particulate catalyst precursor in the calcination zone, wherein a maximum variation of the temperature as a function of time is  $\leq 5^\circ \text{C.}$ ; wherein a maximum local temperature difference in the calcination zone is  $\leq 5^\circ \text{C.}$ ; and wherein said catalyst comprises an active phase of said multimetal oxide material.

U.S. 6,867,278 uses the term “substantially constant” with respect to the branch distribution profile as follows:

1. A composition comprising a PE-100 copolymer of ethylene and 1-hexene having an average molecular weight greater than about 300,000 g/mol, a **substantially**

**constant** branch distribution profile at molecular weights greater than about  $1 \times 10^4$ , and a HLMI of less than about 3.5.

U.S. 6,844,370 uses the term “substantially constant” with respect to the pH during catalyst formation as follows:

6. The process of claim 1 wherein, in the preparation of the catalyst, an iron composition is precipitated at a **substantially constant** pH wherein the iron containing solution and an alkali are added to each other in order to retain the pH **substantially constant**.

U.S. 6,780,815 uses the term “substantially constant” with respect to catalyst temperature as follows:

5. A process for activating a chromium oxyfluoride catalyst to produce an activated catalyst useful in the vapor phase fluorination reaction of a halohydrocarbon with hydrogen fluoride comprising: a. drying the catalyst to obtain a substantially moisture free catalyst; b. fluorinating the dried catalyst with a first activating gas at a first pressure substantially below the operating pressure of the catalyst to produce a reaction product containing activating gas and water while maintaining the temperature of the catalyst below about 215° C. for a time sufficient to achieve a **substantially constant** catalyst temperature under adiabatic conditions; c. substantially avoiding recycling of any reaction product of the fluorination step (b) to said step (b); d. fluorinating the dried catalyst with a second activating gas, which is the same as or different than the first activating gas, at a second pressure substantially above said first pressure to produce a reaction product containing activating gas and water while maintaining the temperature of the catalyst above about 215°C. and below about 375°C. (about 700°F.) for a time sufficient to achieve a substantially constant catalyst temperature under adiabatic conditions; and e. separating a substantial portion of the water present in the reaction product of fluorination step (d) into a water rich product and a water lean product and recycling at least a portion of said water lean product to reaction step (d).

U.S. 6,777,381 uses the term “substantially constant” with respect to viscosity of a surfactant paste as follows:

1. A process for preparing a solvent-based surfactant paste comprising the steps of: A) forming an aqueous surfactant mixture by blending, by weight of the mixture: (a) from about 5% to about 85% of an anionic sulfonated surfactant; (b) from about 15% to about 95% of an organic solvent; (c) from about 0.001% to about 40% of a chelant;

wherein the aqueous surfactant mixture a water content of about 5% to 80% by weight of the aqueous surfactant mixture and the aqueous surfactant mixture is a non-Newtonian fluid; B) drying the aqueous surfactant mixture under vacuum to form the solvent-based surfactant paste having a wafer content of less than about 1% and which is in the form of a Newtonian fluid having a **substantially constant** viscosity

within the range of 100 cp to 100000 cp when measured at a temperature of 25°C. and within the shear rate range of from  $1 \text{ s}^{-1}$  to  $1000 \text{ s}^{-1}$ .

U.S. 6,732,796 uses the term “substantially constant” with respect to temperature of a production well as follows:

16. The method of claim 1, wherein removing a portion of the second synthesis gas comprises producing the second synthesis gas through at least one production well, wherein a temperature of at least one production well adjacent to a second synthesis gas production zone is maintained at a **substantially constant** temperature such that the second synthesis gas comprises a greater  $\text{H}_2$  to CO ratio than the first synthesis gas.

U.S. 6,638,341 uses the term “substantially constant” with respect to equilibrium temperature value as follows:

23. A method as in claim 1 wherein said steps a., b. and c. are repeated until the temperature within said vessel passes through a maximum value and decreases to a **substantially constant** equilibrium value.

U.S. 6,525,149 uses the term “substantially constant” with respect to reaction temperature as follows:

1. A liquid phase polymerization process for preparing a polyolefin product having preselected properties, said process comprising: providing a liquid feedstock comprising at least one olefinic component; providing a catalyst composition comprising a stable complex of  $\text{BF}_3$  and a complexing agent therefor; introducing said feedstock and said catalyst composition into a residual reaction mixture in a loop reactor reaction zone; recirculating the residual reaction mixture in said zone at a recirculation rate sufficient to cause intimate intermixing of the residual reaction mixture, the feedstock and the catalyst composition to thereby present a recirculating, intimately intermixed reaction admixture in said reaction zone; maintaining the recirculating intimately intermixed reaction admixture in its intimately intermixed condition and removing heat of reaction from the reaction admixture at a rate calculated to provide a **substantially constant** reaction temperature in the reaction admixture while the same is recirculating in said reaction zone, said constant reaction temperature being at a level appropriate for causing olefinic components introduced in said feedstock to undergo polymerization to form said polyolefin product in the presence of said catalyst composition; withdrawing a product stream comprising said polyolefin product from said reaction zone; and controlling the introduction of said feedstock into said reaction zone and the withdrawal of said product stream from the reaction zone such that the residence time of the olefinic components undergoing polymerization in the reaction zone is appropriate for production of said polyolefin product, wherein the reaction admixture is continuously recirculated at a first volumetric flow rate, and said feedstock and said catalyst composition are continuously introduced at a combined second volumetric